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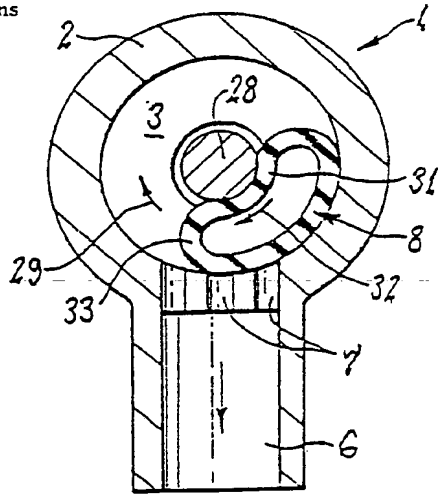
(54) Title: VALVES

(57) Abstract

Valves (1) including an apertured body (2) allowing the passage of fluid may be sealed by a resilient closure (8) actuated by actuating means (28) so as to roll a portion of the closure (8) over the aperture (7).



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VALVES

This invention relates to valves.

Many different types of valve have been proposed for use in the control of fluid flow. Valves commonly in use include a valve body having at least one aperture through which fluid may pass and some form of valve closure which may be moved so as to cover the aperture and prevent or restrict passage of fluid through the aperture. Some such valve closures employ flexible or resilient materials to assist in forming and maintaining the cover of the aperture.

However, as far as applicant is aware, none of the valves suggested by the prior art are constructed or actuated in a similar manner to the valves of the present invention.

The present invention provides a valve comprising a body, an aperture in a surface of said body through which fluid may pass, a resilient valve closure having a surface comprised of a first portion in contact with said surface of said body, a second portion out of contact with said surface of said body and a third, curved, portion interconnecting the first portion and the second portion, and actuating means for causing a rolling of said closure such as to cause at least part of said third portion to move to overlie said surface of said body in the region of said aperture and to cause at least part of the second portion to take up a curved position similar to that of said third portion, said rolling thereby providing for said closure to close said aperture.

The valve closure may be a solid body able to roll along said surface of the valve body. In this respect the closure might be spherical or conical but preferably the closure, if solid, is cylindrical. The use of a solid body valve closure is preferred if the valve is to be subjected to high pressures.

However, there are many applications of the invention where it is preferred that the cross section of the valve closure comprises a loop of material comprised of two lengths joined by a bight. The loop may be an open loop in which case said lengths will have definite ends or the loop may be a closed loop in which case a second bight joins said lengths.

In the case of an open loop it is preferred that one of the definite ends of said lengths is physically connected to said surface of said body and that the other of the definite ends of said lengths is physically connected to the actuating means. The physical connection may be achieved in any suitable way such as by rivets, screws, pins, pegs, capture or adhesive.

In the case of a closed loop it is generally preferred that there is no physical connection of the loop with the apertured surface of the valve body and the actuating means unless some limit to movement is desired.

The apertured surface of the valve body may be planar or curved.

The valve closure may be made of any suitable material but particularly preferred materials include metals, rubbers, both synthetic and natural and resilient synthetic plastics materials. In general, materials suitable for the closure are those sufficiently resilient to withstand the flexing and strength sufficient to withstand the pressures which will be encountered. Among materials which have been used are mylar film, reinforced rubber sheet, polyurethane rubber, stainless steel spring tape, silicone rubber and neoprene rubber. Of particular interest is that the closure may simply be a length of resilient tubing.

The actuating means may include a member which moves linearly, in an arc or rotates or revolves. That member may be physically connected to the closure as previously stated but in many instances no more than a frictional engagement will be required.

Specific constructions of valves in accordance with this invention will now be described by way of example with the aid of the accompanying drawings in which:

Figure 1 is a cross-sectional view of a first valve,

Figure 2 is a cross-sectional view on line A-A in Figure 1,

Figure 3 shows alternative port arrangements,

Figure 4 is a cross-sectional view of a second valve,

Figure 5 is a view of a port of the second valve,

Figure 6 is a cross-sectional view of a third valve,

Figure 7 is a cross-sectional view of a fourth valve,

Figure 8 is a cross-sectional view on line B-B in Figure 7.

Figure 9 is a cross-sectional view of a fifth valve,

Figure 10 is a cross-sectional view on line C-C in Figure 9, and

Figure 11 is a cross-sectional view of a sixth valve.

The first valve as shown in Figures 1 and 2 comprises a first body part 2 having a cylindrical inner chamber 3, an axial inlet 4 to the chamber 3 and a peripheral outlet 6 from the chamber 3. The members defining inlet 4 and outlet 6 may be threaded for connection to piping. The outlet 6 is provided with a plurality of small ports 7 so as to leave a substantial portion of the cylindrical wall of the chamber 3 available to support a valve closure 8. The first body part 2 also has a recess 9 in which an 0-ring seal 21 is received. The first valve also includes a second body part 22 which is secured to the first body part 2 in any convenient way.

The second body part 22 has a recess 23 in which is located an 0-ring seal 24 and supports a shaft 26 having an outer end 27 which may be rotated in any convenient way such as by hand and an inner end 28 which will be turned by the outer end 27. To assist rotation of shaft 26, a knob or similar device may be mounted on its outer end 27.

The valve closure 8 is a length of cylindrical flexible tubing which has been forced into the space between the inner end 28 and the cylindrical wall of the chamber 3 and so has taken up the curved oval shape seen in Figure 2.

On rotation of the inner end 28 in the direction of the arrow 29 in Figure 2 the section 31 of the closure 8 will move in the direction of the arrow 32 so that some of it replaces part of the curved portion 33 and so that part of the curved portion 33 overlies the ports 7 and hence closes the outlet 6 of the first valve.

Opening the first valve can be performed by reversing the direction of rotation of the inner end 28 or by continuing to rotate it in the direction of the arrow 29.

Since the closure 8 is flexible it may need substantial support in the area of the outlet 6. Various

alternative shapes of outlet ports are shown in Figure 3. Where a single large port is required, the closure may be supported by appropriate internal reinforcement.

Another shape of outlet port is shown in Figure 5 and the shape chosen will depend on the application of the valve. The fine control allowed by the shape of the port in Figure 5 can be further refined by extending the narrow end of the port with a tapered channel in the adjacent surface of the valve body. The depth of the channel progressively increases as the channel approaches the port.

The second valve 40 as shown in Figure 4 comprises a body 41, a linearly reciprocable actuator 42, O-ring seals 43, a cavity in the body 41 having a surface 44 provided with an outlet port 46, an inlet 47 and a valve closure 48 which is a flexible strip of material secured to the surface 44 by a screw 49 and to the actuator 42 by screws 51.

The closure 48 has an upper section 52, a lower section 53 and a curved portion 54.

Moving the actuator to the left in Figure 4 will cause a rolling motion in which part of the lower section 53 moves to form part of the curved portion between the upper and lower sections and at the same time uncovers the port 46 to a selected degree while part of the curved portion 54 moves to become part of the upper section. Closing the valve is effected by reversing the direction of movement of the actuator 42. Since the port 46 is obliquely shaped the amount and flow rate of fluid let out therefrom can be carefully controlled.

A valve incorporating a valve closure of similar operation to that of closure 48 may be used as a cistern outlet valve. In this application, linearly reciprocable actuator 42 to which the closure is attached is replaced by a plate at the end of a pivotally mounted arm. The arcuate movement of the plate when the control lever at the opposite end of the arm is moved substantially corresponds to the linear reciprocation of actuator 42. The plate or end of the arm adjacent the attachment of the plate to the closure may be weighted to assist return of the closure to its sealing position.

The third valve 60 as shown in Figure 6 has an inlet

61 which is peripheral and there are two outlets 62 and 63. Valve closure 64 is a piece of tube having a closed loop cross-section and is connected to an inner surface 66 and to a rotatable shaft 67. Rotation of the shaft 67 will cause a rolling of the closure 64 to cover and uncover the outlets 62 and 63 to a selected extent. This valve may thus be used to allow complete or proportional flow from the two outlets.

In the fourth valve 70 as shown in Figures 7 and 8 body parts 71 and 72 are sealed by an 0-ring 73, a shaft 74 is sealed by an 0-ring 76, body part 71 has an inlet 76 and an outlet 77 and a valve closure 78 comprises a strip of flexible material connected to surface 79 of the body part 71 and to the shaft 74. Rotation of the shaft 74 will cause a rolling of the closure 78 to uncover and cover the outlet 77.

In the fifth valve 80 as shown in Figures 9 and 10 two body parts 81 and 82 define a cavity 83 having surfaces 84 and 86 through which outlets 87 and 88 extend. An inlet 89 is provided in the part 81. A linearly reciprocable actuator 91 is sealed with 0-rings 92.

Between the actuator 91 and surfaces 84 and 86 are two closures 95 and 93. The closures 95 and 93 are lengths of flexible tubing of circular cross-section but which have become generally oval due to constriction between the actuator 91 and respective ones of the surfaces 84 and 86.

As shown in Figure 9, the outlet 87 is closed and the outlet 88 is open. If the actuator 91 is moved to the right in Figure 9 the closures 93 and 95 will roll on the actuator 91 and surfaces 84 and 86 to the positions shown in dash lines to open outlet 87 and close outlet 88.

Figure 11 shows a sixth valve 100 similar in construction to that of Figures 1 and 2 but applied to a valve for use in the supply of blood or saline solution. Actuator shaft 101 for closure 102 moves with a cover plate rotatably attached to body part 103. The cover plate movement and hence adjustment of the position of closure 102 is facilitated by lever arm 104 which forms part of the cover plate. Channel 105, the size of which is exaggerated in the figure, is tapered in depth as shown and may also be tapered in width to provide fine flow rate adjustment from port 106.

Each of the different forms of valve shown in the drawings differs in detailed construction but each incorporates the principles of the present invention. The invention can thus be applied to many different uses and it is to be understood that the examples illustrated in the drawings are not intended to limit the scope of the invention.

Valves in accordance with this invention are relatively simple and correspondingly cheap to make. For example, simple castings or machining can be used, there is unlikely to be any critical machining, O-rings may be used to provide good seals between fixed or movable parts, low operating force is required, substantial pressure can be resisted and the valve is suitable for corrosive liquids or gases. Dirt in the fluid is not a great problem as the flexibility of the closures allows at least partial compensation for the presence of dirt particles.

Valves in accordance with this invention may be applied industrially or domestically for hot and cold fluids. The valves may be solenoid or motor controlled and pneumatic, hydraulic and vacuum applications are possible. Multi-port valves, cistern and float valves, and metering valves may be made.

One particular application is in respect of valves for medical use such as in supplying blood, saline solution or gases in that valves in accordance with this invention maintain delivery at a controlled rate after setting apart from normal dependence on pressure head variation.

CLAIMS

1. A valve comprising a body, an aperture in a surface of said body through which fluid may pass, a resilient valve closure having a surface comprised of a first portion in contact with said surface of said body, a second portion out of contact with said surface of said body and a third, curved, portion interconnecting the first portion and the second portion, and actuating means for causing a rolling of said closure such as to cause at least part of said third portion to move to overlie said surface of said body in the region of said aperture and to cause at least part of the second portion to take up a curved position similar to that of said third portion, said rolling thereby providing for said closure to close said aperture.

2. A valve as claimed in claim 1 wherein said valve closure cross-section consists of a loop of material including two lengths joined by at least one bight.

3. A valve as claimed in claim 2 wherein said valve closure cross-section consists of a closed loop.

4. A valve as claimed in claim 3 wherein said valve closure consists of a length of resilient tubing.

5. A valve as claimed in claim 2 wherein said valve closure cross-section is an open loop.

6. A valve as claimed in claim 3 wherein said valve closure is not physically connected to said valve body or to said actuating means.

7. A valve as claimed in claim 3 or claim 5 wherein said valve closure first portion is physically connected to said valve body and said valve closure second portion is physically connected to said actuating means.

8. A valve as claimed in claim 1 wherein said valve body includes an inlet and an outlet including said aperture, said valve closure consists of a length of resilient tubing partly compressed between said valve body and said actuating means including a shaft colinear with said length of tubing and rotatable so as to cause said rolling of said closure.

9. A valve as claimed in claim 1 wherein said valve

body includes an outlet including said aperture, said valve closure includes a strip of resilient material having one end portion connected adjacent said aperture and the other end portion connected to said actuating means, said actuating means being reciprocable so as to cause said rolling of said closure.

10. A valve as claimed in claim 1 wherein said valve body includes one inlet and two outlets, each said outlet including at least one said aperture, said valve closure includes a strip of resilient material held with closed loop cross-section by connection of one portion between the outlets and another portion to said actuating means, said actuating means including a shaft colinear with said looped strip and rotatable so as to cause said rolling of said closure to close the respective apertures.

11. A valve as claimed in claim 1 wherein said valve body includes an inlet and an outlet including said aperture, said valve closure includes a strip of resilient material held with open loop cross-section by connection of one end portion between said inlet and outlet and the other end portion to said actuating means, said actuating means including a shaft colinear with said looped strip and rotatable so as to cause said rolling of said closure.

12. A valve as claimed in claim 1 wherein said valve body includes one inlet between two spaced and oppositely directed outlets, each said outlet including at least one said aperture, two said valve closures each comprising a length of resilient tubing mounted on but not physically connected to opposite sides of said actuating means, said actuating means including a shaft reciprocable so as to cause said rolling of said closures between said outlets.

AMENDED CLAIMS
(received by the International Bureau on 8 April 1982 (08.04.82))

(amended) 1. A valve comprising a body, an aperture in a surface of said body through which fluid may pass, a resilient valve closure having a continuous closed surface comprised of a first portion in contact with said surface of said body, a second portion out of contact with said surface of said body and a third, curved, portion interconnecting the first portion and the second portion, and actuating means for causing a rolling of said closure such as to cause at least part of said third portion to move to overlie said surface of said body in the region of said aperture and to cause at least part of the second portion to take up a curved position similar to that of said third portion, said rolling thereby providing for said closure to close said aperture.

(amended) 2. A valve as claimed in claim 1 wherein said valve closure cross-section consists of a closed loop.

(amended) 3. A valve as claimed in claim 2 wherein said valve closure consists of a length of resilient tubing.

(amended) 4. A valve as claimed in claim 1 wherein said valve closure is not physically connected to said valve body or to said actuating means.

(amended) 5. A valve as claimed in claim 1 wherein said valve body includes an inlet and an outlet including said aperture, said valve closure consists of a length of resilient tubing partly compressed between said valve body and said actuating means including a shaft colinear with said length of tubing and rotatable so as to cause said rolling of said closure.

(amended) 6. A valve as claimed in claim 1 wherein said valve body includes one inlet and two outlets, each said outlet including at least one said aperture, said valve closure includes a strip of resilient material held with closed loop cross-section by connection of one portion between the outlets and another portion to said actuating means, said actuating means including a shaft colinear with said looped strip and rotatable so as to cause said rolling of said closure to close the respective apertures.

(amended) 7. A valve as claimed in claim 1 wherein said valve body includes one inlet between two spaced and oppositely directed outlets, each said outlet including at least one

said aperture, two said valve closures each comprising a length of resilient tubing mounted on but not physically connected to opposite sides of said actuating means, said actuating means including a shaft reciprocable so as to cause said rolling of said closures between said outlets.

(amended) 8. A valve comprising a body, an aperture in a surface of said body through which fluid may pass, a resilient valve closure having a surface comprised of a first portion in contact with said surface of said body, a second portion out of contact with said surface of said body and a third, curved, portion interconnecting the first portion and the second portion, and actuating means for causing a rolling of said closure such as to cause at least part of said third portion to move to overlie said surface of said body in the region of said aperture and to cause at least part of the second portion to take up a curved position similar to that of said third portion, said rolling thereby providing for said closure to close said aperture, wherein said valve body includes an inlet and an outlet including said aperture, said valve closure includes a strip of resilient material held with open loop cross-section by connection of one end portion between said inlet and outlet and the other end portion to said actuating means, said actuating means including a shaft colinear with said looped strip and rotatable so as to cause said rolling of said closure.

9-12 (cancelled)

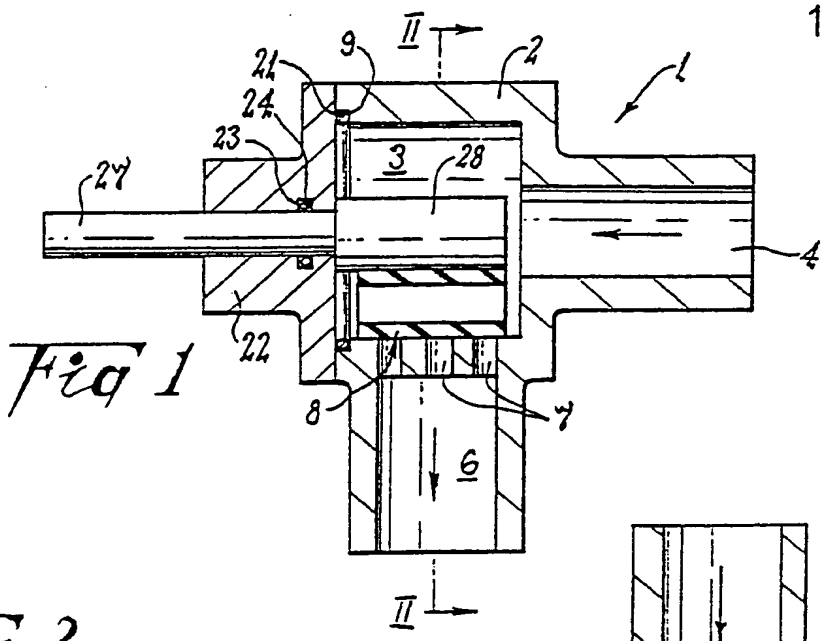
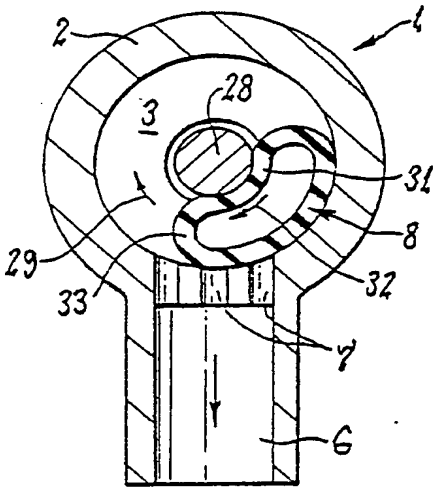


Fig 1

Fig 2



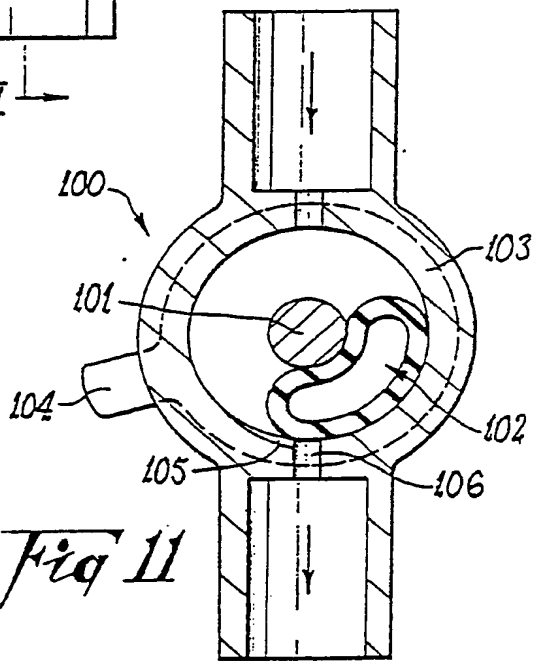


Fig 11

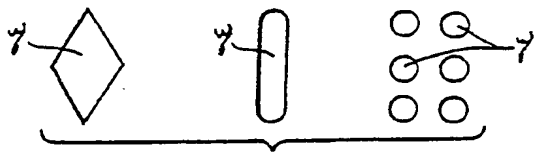


Fig 3

Fig 5

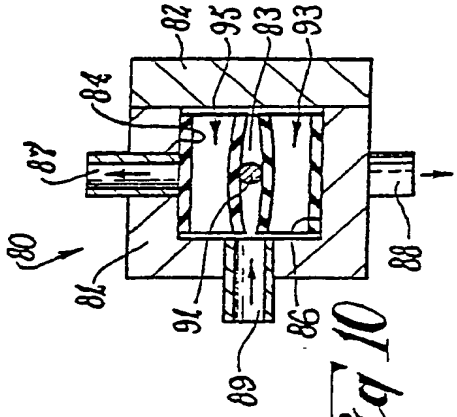


Fig 10

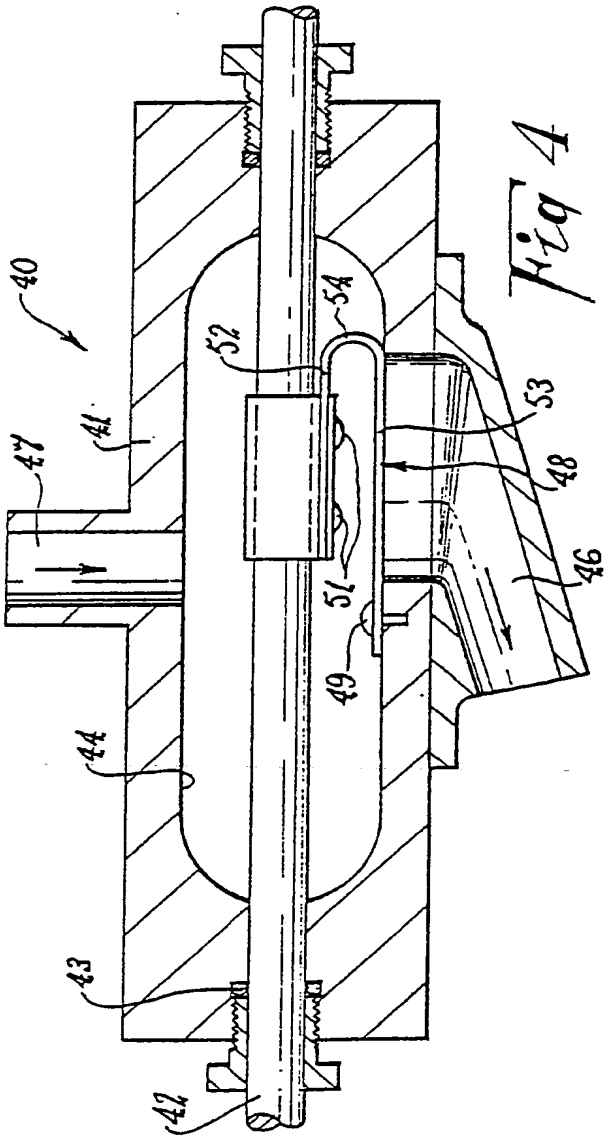


Fig 4

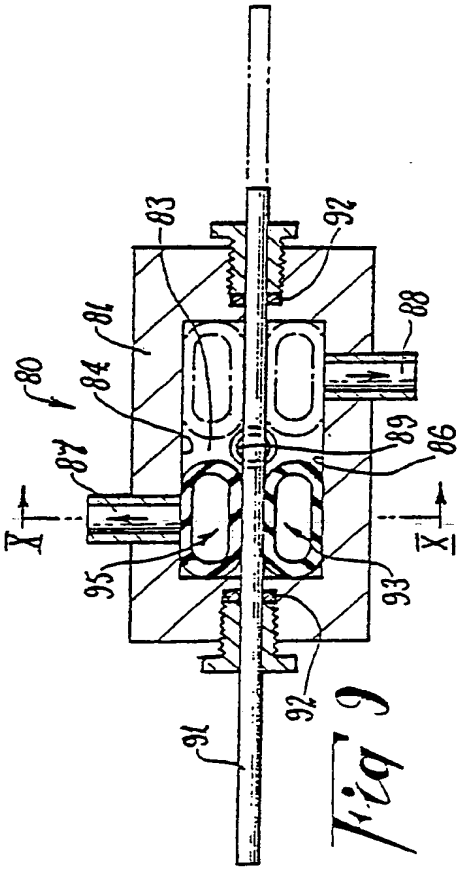


Fig 9

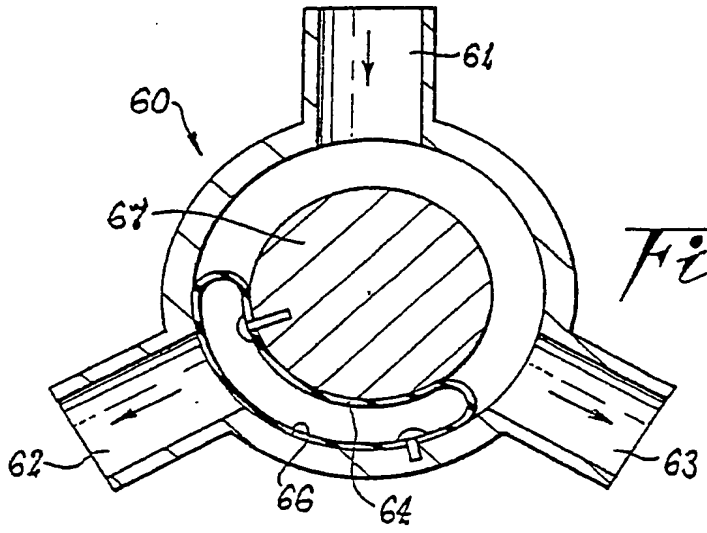


Fig 6

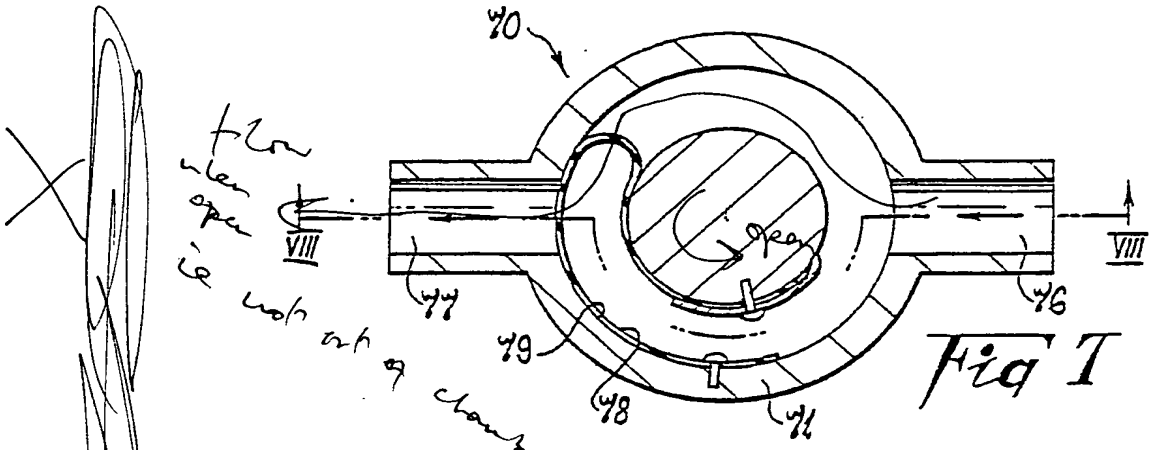


Fig 7

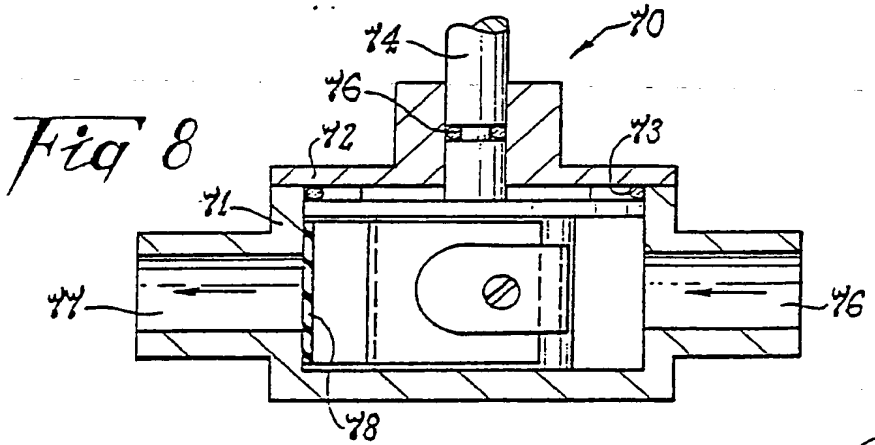


Fig 8

INTERNATIONAL SEARCH REPORT

International Application No PCT/AU81/00184

I. CLASSIFICATION OF SUBJECT MATTER (If several classification symbols apply, indicate all) [3]

According to International Patent Classification (IPC) or to both National Classification and IPC

Int. Cl.[3] F16K 7/18

II. FIELDS SEARCHED

Minimum Documentation Searched [4]

Classification System	Classification Symbols
IPC	F16K 7/18

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [5]

AU: IPC as above; Australian Classification 74.71

III. DOCUMENTS CONSIDERED TO BE RELEVANT [14]

Category *	Citation of Document, [16] with indication, where appropriate, of the relevant passages [17]	Relevant to Claim No. [18]
X	AU,B, 60851/73 (470419) (BRYANT) 10 April 1975 (10.04.75)	(1-2,7)
X	AU,B, 54672/73 (465902) (ALBANY ENGINEERING SYSTEMS) 24 October 1974 (24.10.74) See pages 7-9	(1-2,9)
X	AU,B, 41380/72 (455017) (LIQUIDS CONTROLS CORPORATION) 25 October 1973 (25.10.73) See pages 5-6 (& GB,A, 1380156, & DE,A, 2218987)	(1-2,7,9)
X	US,A, 2720218 (OTTO) 11 October 1955 (11.10.55)	(1,3-4)
X	US,A, 2180173 (SHARE) 14 November 1939 (14.11.39) See page 2.	(1-2,7,9)

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IV. CERTIFICATION

Date of the Actual Completion of the International Search [1]	Date of Mailing of this International Search Report [2]
3 February 1982 (03.02.82)	08 FEBRUARY 1982 (08-02-82)
International Searching Authority [1]	**Signature of Authorized Officer [20]**
Australian Patent Office	R.J. SAWYER

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